IUCN UK Committee Peatland Programme
*Briefing Note Nº**12***

Tracks across peatlands

IUCN | National Committee United Kingdom
Peatland Programme

Introduction

Tracks have been made across peatlands for as long as human society has existed. **Un-made tracks** (i.e. those created simply by regular use, with no construction involved) were probably first created by grazing animals and then presumably also used by early human communities. Finding these increasingly impassable with regular use, human societies began to construct 'corduroy roads' during Neolithic, Bronze and Iron Age times. These first **constructed tracks** were made from cut timbers (*below*). Across Europe, many examples of these corduroy roads have been found preserved in lowland bogs, perhaps most famously in the Somerset Levels and more recently at Hatfield Moors on the Humberhead Levels.

The need arises for such trackways because bogs are wetland systems. Peat accumulation only occurs because the system is waterlogged (see ***Definitions Briefing Note 1***), being typically 95% water and 5% organic matter by weight, therefore making the ground surface very soft. Even when actively drained, bog systems rarely contain less than 75-80% water by weight and thus remain about as soft as a peeled banana! In its natural state a peat bog retains its structural integrity due to the fibrous nature of the living layer and the underlying peat matrix, **but the high water content and sensitivity of the system to trampling make it a particularly challenging environment for an engineer charged with creating a regular access route across deep peat.**

A Bronze Age plank trackway in Clonad Bog.

Track structure and construction methods vary

In former times the difficulties of traversing blanket mire landscapes were minimised by following routes that made as much use as possible of mineral ground and areas of thin peat. Where a track had to cross patches of deeper peat, as was the case with many tracks providing access to community peat-cutting banks, the peat was generally excavated to expose the mineral subsoil, which then offered a much firmer running surface. Such **excavated tracks**, routed as far as possible through areas of thin peat, became the standard engineering approach associated with the post-war intensification of land use practices undertaken across blanket mire landscapes. The deepest areas of peat, however, presented challenges which meant that excavated tracks across these areas were often either technically or economically unattractive. Forestry operations and commercial peat extraction relied on large, wide-tracked vehicles with extremely low ground pressures when working on the deepest peats, but these were not generally feasible options for hill farmers and sporting estates. Consequently the rise of small all-terrain vehicles (ATVs) and quad bikes since the 1980s has offered a new way of accessing difficult ground, replacing the ponies traditionally used for upland estate work. For operations requiring larger vehicles where routes following the topography and thinnest peat soils was not an option, **floating track** construction has increasingly been used in an effort to minimise excavation of deep peat.

Constructed tracks ***Often requires peat to be excavated*** ***Quality of track surface is important***	In recent years there has been a growing need to transport heavy machinery across blanket mire landscapes, particularly to facilitate renewable energy development and forest harvesting. Such developments often involve a network of access and maintenance tracks to specific locations, which cannot always avoid crossing extensive stretches of deep blanket peat. Access tracks are also generally needed subsequent to development for essential repair and maintenance work by heavy cranes and transporters, for which ATVs are not suitable. Consequently some form of **constructed road** is necessary. One approach used for such constructed roads is to excavate all the peat along the route in order to form a stable running surface on the underlying mineral soil. A variant of this approach, the **cut-and-fill road**, is now used in places by the wind farm industry. This method involves removing the peat and filling the resulting trench to the bog surface with locally-sourced crushed stone to provide a stable running surface. Without mitigation to reduce their environmental impact, constructed tracks across peatland have a negative impact on the hydrology of the peat by segregating the peatland into many hydrologically isolated units and under-draining an area of peat alongside the constructed track. Such **excavated roads** are usually used where the peat is relatively thin (typically less than one metre in depth), because the method generates large quantities of excavated peat which must be disposed of in some way, raising formal issues of waste management. It also requires a considerable volume of crushed stone to fill the void. The type and quality of stone used in this type of track construction is crucial to reducing the environmental impact of the track. Aggregate of good, load bearing quality (indicated by the Los Angeles coefficient) will be less likely to break down and cause dust and sediment run-off to the surrounding habitat. The chemistry of the stone is also important e.g. placing alkaline limestone aggregate on a track across acidic bog habitat can have considerable negative hydrochemical impacts on the surrounding peatland.
Floating tracks ***Aims to minimise the need for peat excavation***	Where the peat is greater than one metre deep it becomes increasingly likely that a **floating track** will be used. Applied by Stephenson to 'float' the Liverpool-Manchester railway across Chat Moss using brushwood bundles in the 1800s, this is not a new principle. In contrast, the modern floating road often has no such buoyant layer. It typically relies on the use of a layer of **geotextile or geogrid** (*opposite*), onto which **aggregate** (usually crushed rock) is tipped. For floating tracks through forested areas, brash is often used to form the base of the track. Given that road-construction traffic for developments such as wind farms may involve regular passage by vehicles with payload capacities of 30 tonnes and after turbine construction, crawler

cranes of up to 250 tonnes, the necessary thickness and weight of the carriageway makes subsidence into the peat over time unavoidable (see ***Drainage Briefing Note 3***). The geogrid assists in keeping subsidence relatively uniform across the carriageway width, but it cannot prevent it from occurring. When the carriageway surface subsides, this requires topping off with more aggregate to maintain a uniform running surface, which in turn adds additional weight and compression to the underlying peat. As a result of several processes acting in combination, under continuous and long term use, floating tracks on deep peat can eventually sink to the underlying mineral layer, essentially becoming a cut-and-fill type track with peat displaced to the sides.

Impact of tracks

All *constructed* tracks result in **long term** effects. Apart from direct loss of habitat beneath the route, one of the greatest effects of a constructed track is that in many places it cuts across the general pattern of surface seepage so characteristic of a blanket mire landscape (see ***Definitions Briefing Note 1***). On the upslope side of the road this effect can be very obvious, creating ponding of this surface seepage. This results in a build-up of pressure that can lead to distortion or even collapse of roadway sections in certain circumstances.

Hydrological impacts

Water accumulating on the upslope side of the road would normally have seeped in a diffuse way further downslope, helping to maintain waterlogged conditions across the whole peat-dominated slope. Loss of this water to downslope parts will tend to result in reduced waterlogging and increased drying of the peat surface, particularly during long rain-free periods.

Additional drainage is often installed to maintain the track structure

Where side-drains are dug along the edge of a constructed track to prevent such accumulation of surface water, the direct effect of such drains is to dry out the peat in their vicinity. Even where no drains are dug alongside the road, the pattern of surface seepage is still disrupted by the line of the road, with the downslope area of peatland becoming under-drained. This gives rise to the associated consequences of peatland drainage (see ***Drainage Briefing Note 3***). Where the drains direct the water into culverts beneath the road, this inevitably produces a markedly more focused pattern of flow from the downslope outflow of the culvert than the diffuse surface flow that existed previously. Over time this more focused flow has a tendency to result in development of erosion gullies, which can ultimately threaten the structural integrity of the carriageway. Use of culverts means that some parts downslope will receive more water than before, while other parts receive less seepage. Loss of such diffuse seepage for significant areas, in some cases extending for several hundred metres, downslope from the road can result in drying, leading to primary

consolidation, secondary compression and oxidative loss of the peat where the acrotelm layer is lost (see ***Drainage Briefing Note 3***). Such a haplotelmic bog surface has little resilience to drought and is thus prone to further drying and cracking. If these conditions occur, they can threaten the long-term stability of the peat, and thus the carriageway, particularly during intense storm events, which are predicted to increase (see ***Weathering, Erosion and Mass Movement Briefing Note 9***). Sediment management is paramount on construction sites to minimise risk to the water environment and surrounding habitats. Poor quality aggregate and eroding peat soils result in large volumes of drainage water requiring sediment treatment. It is important that the trackside drainage system is designed to cope with this and that sediment does not smother vegetation.

Whether there is drainage or not, the weight of road material will cause primary consolidation and secondary compression in the peat directly beneath, and, in the longer term, across an increasingly wide band of ground as the subsidence expands outward from the road-line. This long-term subsidence of the road poses challenges to the site manager because if the road sinks below the level of the bog it will become flooded and unusable. Addition of further material to raise the carriageway will cause further, more rapid subsidence. There is thus a tendency over a period of time for such floating roads to become sunken roads (*page 4*), which then act as drains on the surrounding bog habitat. The less material used to create the road initially, the slower the rate of subsidence, although this is also dependent on the nature of the peat and the traffic using the track. Soft wet peat will subside more rapidly than drier, denser peat.

Track becomes a hydrological barrier

Subsidence is an unavoidable feature of floating roads. Some degree of drainage will generally be necessary at some stage in order to prevent the carriageway from flooding. However, drainage itself will induce further primary consolidation and secondary compression and thus subsidence, but also introduce oxidative losses that will continue for as long as the drains continue to function (see ***Drainage Briefing Note 3***).

The *long term* effects of compression and consolidation caused by road material and associated drainage are not restricted to altering the surface hydrology of the bog. A line of increased density *within* the subsided peat will tend to reduce the water content of peat downslope further still, exacerbating the drainage effects described above still further.

Un-constructed tracks can have a negative impact too

While it is true that, for smaller-scale operations, modern ATV quad-bikes and other types of ATVs are now capable of transporting people and supplies across all but the wettest, softest ground, it has also become clear that repeated use of such vehicles along regular routes results in much the same damage to an active bog surface as does repeated heavy trampling (see ***Grazing and Trampling Briefing Note 7***). The living acrotelm layer is quickly destroyed leaving the unprotected catotelm peat (see ***Biodiversity Briefing Note 2***) to be churned up by the action of the tyre treads. As parts of the route become increasingly churned up, a zone of expanding devastation develops

	as drivers wish to avoid becoming bogged down in the most damaged areas. In the worst cases this process can render whole sections of the route impassable, in effect reducing the bog to a bare erosion surface with associated loss of carbon, water quality and other ecosystem services (see ***Erosion Briefing Note 9***). Even where obvious erosion does not occur, a chronic level of ground-pressure disturbance can reduce the extent and vigour of peat-forming species or prevent recolonisation of damaged areas.
Effects of increased access	One overlooked effect of constructed roads which cross blanket bog areas is increased access pressure, although sometimes promoted as a benefit. This pressure has emerged as a particularly marked result of the extensive windfarm road system constructed across the blanket bogs of northern Spain. The road system here has led to a significant increase in pressure from both working and recreational land users because access to these formerly-remote areas is now much easier than before. Whilst increased access for those working on the land brings obvious benefits, if this ease of access also leads to an intensification of land-use development pressures it can give rise to a whole new set of issues. Similarly, while increased enjoyment and appreciation of the blanket mire landscape is to be welcomed, increased visitor pressure brings its own set of issues, not least an increase in trampling and wildfire pressure (see ***Grazing and Trampling Briefing Note 7*** and ***Burning Briefing Note 8***). 
Restoration ***Remove the track…*** ***…or let it be?***	**Unmade tracks have much greater scope for restoration than constructed tracks,** which often consist of an introduced substrate not usually found on a blanket bog surface. Furthermore, there is a strong likelihood that a constructed track, once in place, will become a permanent feature of the landscape because of the work involved in removing it. The potential complications involved and the likely additional damage resulting from doing so are so great that few restoration attempts are likely. However, there will be instances where track removal and restoration of land is a requirement of planning permission and it is therefore an area which needs further consideration and research to minimise the environmental impact of removal. An alternative approach to restoration of a constructed track may simply be to let it become overgrown by fresh bog growth so that it becomes a buried feature within the peat. This assumes that the surrounding bog is in sufficiently vigorous condition that it is capable of overwhelming the road, and even if this does occur, the road itself will form a distinct layer within the peat and may in the future represent a zone of weakness or a potential shear-plane.
Areas at risk	All areas of UK peatland are potentially threatened from the impact of development and associated tracks. Areas of bog habitat without statutory nature designations (e.g. SACs, SSSIs) are considered to be afforded less protection through the planning system and are potentially at a greater risk from construction. Currently the most extensive forms of upland track construction associated with blanket bog habitats arise from either renewable energy developments or game management.

	In Scotland, amendments have been made to the Town and Country Planning Act to prevent damage to landscapes and wildlife: hill tracks are no longer considered to be 'permitted development' and have been brought under planning legislation. The developer of a proposed track must now apply to the local planning authority for a determination. The planning authority will then consider the details of the application and determine whether the route, design or construction methods of the track have potential to cause unacceptable environmental impact. If risks are identified, such as the potential to damage sensitive peatland habitat, then formal planning approval may be required and this would typically be accompanied by an Environmental Impact Assessment (EIA). The EIA should propose a method for removing or reducing the environmental impact of a track.
Benefits of addressing the issue	By addressing the issues of tracks on peat, especially those of constructed tracks, long term drainage, erosion, climate change and biodiversity impacts should be minimised, and may ultimately lead to the restoration of the full complement of **ecosystem services** being provided by the surrounding peatland ecosystem.

Gaps in knowledge	1. Investigations into the long term hydrological impacts of tracks, particularly floating roads, and the resulting carbon loss due to drainage effects.
	2. Investigations into the impacts of novel construction methods, such as:
	  a. Displacement: large rock fill is pushed directly into the peat until it builds a solid layer up to the ground surface;
	  b. Track construction methods across hagged areas of peat;
	  c. Soil stabilisation methods.
	3. The relationship between track construction, long-term presence of such tracks and the geotechnical structure of the peat, including compression layers, peat pipes and cracking.
	4. The relationship between the geotechnical properties of peat and the botanical composition of peat-forming vegetation, and the way in which geotechnical properties change with loading.
	5. Potential for advanced and improved geotextiles which minimise impact.
	6. Potential for vehicle design with minimal ground-pressure.
	7. Effective methods for removal and restoration of unmade and constructed tracks.

Practical Actions	• Contact the relevant statutory agencies at the earliest opportunity for advice regarding track construction methods. This will allow the track design to minimise environmental impact and to allow for environmental sensitivities, such as peatlands, to be adequately taken into account in track design. • Consideration could be given to introducing a formal application process for track construction across the UK and bringing hill tracks under the Town and Country Planning Act, as has been recently (2014) adopted in Scotland. • Rigorous application and use of published government guidance for construction on peat soils by landowners, developers and regulatory authorities • Where tracks are necessary, minimise impacts as much as possible by careful positioning and employ mitigation measures to maintain hydrological connectivity and minimise peat displacement, as per published government guidance.
More Information	IUCN UK Peatland Programme briefings http://www.iucn-uk-peatlandprogramme.org/resources/iucn-briefing-notes-peatlands?destination=node%2F277

SNH 'Constructed tracks in the Scottish Uplands'
http://www.snh.gov.uk/publications-data-and-research/publications/search-the-catalogue/publication-detail/?id=513

Forestry Commission 'Forest roads and tracks'
http://www.forestry.gov.uk/pdf/ON025-ForestRoadsandTracksv1.0issued110809.pdf/$FILE/ON025-ForestRoadsandTracksv1.0issued110809.pdf

Natural England 'The impacts of tracks on the integrity and hydrological function of blanket peat'
http://publications.naturalengland.org.uk/publication/5724597

This briefing note is part of a series aimed at policy makers, practitioners and academics to help explain the ecological processes that underpin peatland function. Understanding the ecology of peatlands is essential when investigating the impacts of human activity on peatlands, interpreting research findings and planning the recovery of damaged peatlands.

These briefs have been produced following a major process of review and comment building on an original document: Lindsay, R. 2010 'Peatbogs and Carbon: a Critical Synthesis' University of East London. published by RSPB, Sandy. http://www.rspb.org.uk/Images/Peatbogs_and_carbon_tcm9-255200.pdf This report is also available at high resolution and in sections from: http://www.uel.ac.uk/erg/PeatandCarbonReport.htm

The full set of briefs can be downloaded from: www.iucn-uk-peatlandprogramme.org.uk

The International Union for the Conservation of Nature (IUCN) is a global organisation, providing an influential and authoritative voice for nature conservation. The IUCN UK Peatland Programme promotes peatland restoration in the UK and advocates the multiple benefits of peatlands through partnerships, strong science, sound policy and effective practice.

We are grateful to Scottish Natural Heritage, Defra, Natural Resources Wales, RSPB Scotland and the Peter de Haan Charitable Trust for funding support.

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Version Date: 18th March 2016